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# Nuclear Related Activities in Burma

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# Nuclear Related Activities in Burma

## *Introduction*

The Democratic Voice of Burma has been accumulating information about a nuclear program in Burma for years, but recently they have come across a source with truly extraordinary information. He worked in special factories making prototype components for missile and nuclear programs. Like the Israeli technician, Mordecai Vanunu, he has brought hundreds of color photographs of the activities inside these factories. DVB has asked us to organize this information and analyze what it means. The goal of this report is to report our findings to DVB in support of their documentary film on Al Jazeera. We are also providing a great deal of raw data for the nonproliferation community to assess.

Burma is one of the world's most repressive regimes. It is ruled by a junta of generals who have been in power for decades. These generals seem to have no political philosophy, such as socialism or fascism, only pure simple greed. To remain in power they depend on a brutal secret police and suspension of most human rights. With the passage of time they seek more ways to hang onto power as their wealth grows ever larger and the dissatisfaction of the population threatens to oust them.

There are many signs that Burma looks to maintain power by having military power that would make foreign intervention very painful for an aggressor. The power may not be necessarily aimed at aggression by Burma on its neighbors; rather it is a defensive power that signals its neighbors to leave them alone. The model for this is the Democratic People's Republic of Korea, DPRK, commonly known as North Korea. North Korea is too poor to threaten anyone except its immediate neighbors but its possession of nuclear weapons inhibits any outside intervention in its repressive regime.

There are many reports of a nuclear program in Burma.[3] Most of them have been sketchy and in some cases technically incredible. Now the Democratic Voice of Burma (DVB) has assembled a huge new body of information that clearly suggests that Burma is investigating nuclear technology. The majority of the new information comes from one source, which is always a concern for credibility. This source is an educated man, a former Burmese Army Major, Sai Thein Win (STW), who understands what he knows and separates his information into what he knows well and what is hearsay. He has a good sense of the organization of Burma's special military programs and is much more of an expert on their missile projects than he is on nuclear matters. His information on nuclear program organization is impressive and it correlates well with information from other published and unpublished sources. But the most important thing he has brought forth is hundreds of color photographs taken inside critical facilities in Burma. Photographs could be faked, but there are so many and they are so consistent with other information and within themselves that they lead to a high degree of confidence that Burma is pursuing nuclear technology. Our analysis leads to only one conclusion: this technology is only for nuclear weapons and not civilian use or nuclear power.

[3] Such as: "Burma's Nuclear Secrets", *The Sydney Morning Herald*, August 1, 2009: http://www.smh.com.au/world/burmax2019s-nuclear-secrets-20090731-e4fv.html

## *Background and Organization of a Program*

There is very little doubt that Burma has a nuclear program. It is headed by Dr. Ko Ko Oo who has attended meetings abroad and openly asserts his interest in nuclear matters. This program has a small connection to the International Atomic Energy Agency (IAEA) in Vienna. The ties to IAEA are in mostly in civil matters such as the use of isotopes in medicine and agriculture, but there are also training courses for Burmese scientists in nuclear technology. Burma does not have any declared nuclear facilities and it claims to have little or no nuclear material.[4] This situation means that the IAEA does not conduct any inspections in Burma because both sides have agreed there is nothing to inspect. The situation with IAEA will be explained in more detail later in this paper.

Currently Burma's nuclear effort is managed by the Directorate of Defence Services Science and Technology Research Center (DDSSTRC). This organization is located in May Myo, also called Pyin Oo Lwin at the Defense Services Technological Academy (DSTA). It is a large complex for the education of military officers and for research. It is primarily a headquarters site and probably does not conduct experimental research, at least with nuclear materials or explosives.

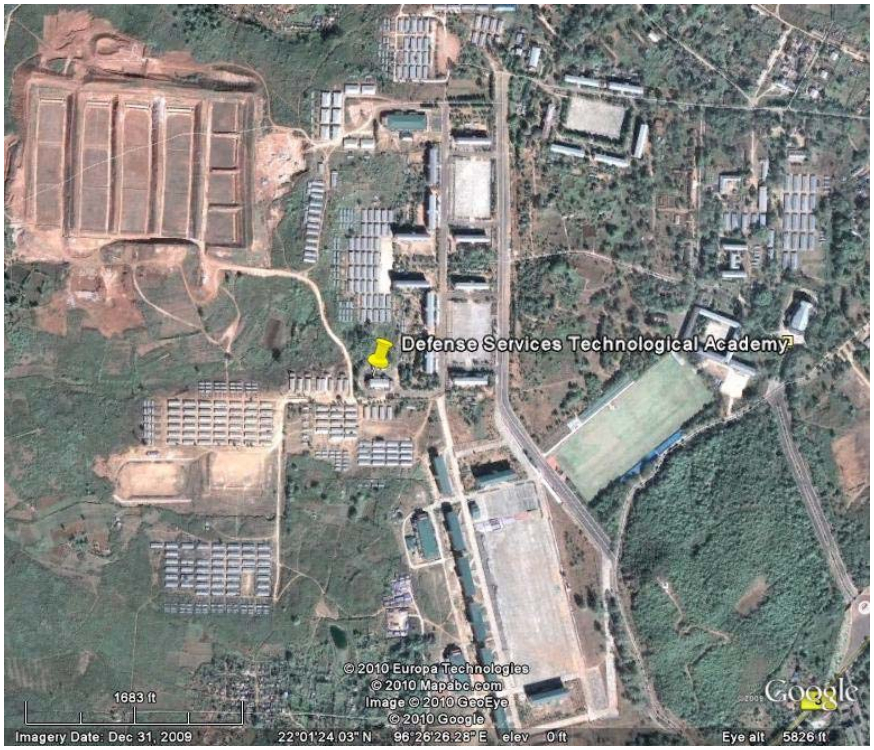


**Figure 1. Defense Services Technological Academy at Pyin Oo Lwin**

[4] There are legal definitions of "nuclear facilities" and "nuclear materials" in the IAEA statute and IAEA Information Circular INFCIRC/153. Burma has not declared any materials in these categories, and short of allegations that we and others are making, there are no legally declared nuclear facilities or materials in Burma.

The scientific side of the nuclear program is run by the Ministry of Science and Technology (MOST), headed by Minister U Thang. Beneath Thang is the Director General of MOST, Dr. Ko Ko Oo. Dr. Oo is the most public face of MOST and its nuclear activities. An example is an invitation to a June 2010 training course sponsored by IAEA where Dr. Oo is the addressee to choose participants from Burma.[5] It is vital to note that Dr. Oo has also served as director of the Department of Technical and Vocational Education (DTVE), which is a front for military procurement activities. It will become clear later in this report that DTVE has been purchasing equipment for the nuclear and missile programs. There is also a Department of Atomic Energy (DAE) in Burma. The DTVE and DAE at one point shared an address, phone number and fax number according to an excellent and detailed report by Andrea Stricker of ISIS.[6] In 2002 Dr. Oo gave his email address at DAE in his personal data at a conference.[7]

The DDSSTRC is responsible for a program, which according to sources, is charged with building a nuclear reactor, enriching uranium, and building a nuclear weapon. It is clear that this is a very difficult task for Burma to successfully accomplish. Much of what STW is providing suggests Burma has little chance of succeeding in its quest, but that does not change the fact that even trying to build a bomb is a serious violation of its international agreements. It would also seem that the very act of trying to build nuclear weapons is a sign of desperation and fear, no matter how unlikely it is to succeed.

## *Thabeikkyin*

Our assessment of multiple sources is that Burma is really developing nuclear technology, that it has built specialized equipment and facilities, and it has issued orders to a cadre to build a program. The cadre in charge is known as the Number 1 Science and Technology Regiment at Thabeikkyin.[8] It is colloquially referred to as the "Nuclear Battalion" and we will adopt that term as well. Major General Sein Win and Lt.-Col. Win Ko have signed a document directing a special factory to produce a part for the No. (1) Scientific and Technology Regiment.

This document is important and will surface again when we look at equipment that is needed for the Nuclear Battalion. There are many reported activities at Thabeikkyin. Previous reports have associated it with mining or ore concentration. This latest source goes further and describes it as a site where "dangerous" ore is brought and

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[5] Prospectus, IAEA/RCA Training Course on Reporting in Advanced Clinical Applications of Positron Emission Tomography (PET), 29 March 2010, http://www.rcaro.org/board/data/rca_whatisnew/6049RTC16AUG10AUL.pdf

[6] Deep Connections between Myanmar's Department of Technical and Vocational Education and Department of Atomic Energy, Andrea Scheel Stricker, January 28, 2010, http://isis-online.org/uploads/isis-reports/documents/Myanmar_DAE_DTVE_28January2010.pdf

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[8] Transliterations vary and not all places in this report will be written multiple ways. Thabeikkyin is such an important site that it is important to know the alternative transliterations Tha Beik Kyin and Tha Peik Kyin.

stored. He also believes that the site is involved in trying to produce "yellowcake" but he is not sure what this material is or if they have been successful.

In Google Earth imagery we can see a small ore concentration plant and ore reserve about 7 miles east of the Irrawaddy River at Thabeikkyin. This is very close to the point STW describes. A group of buildings with one thickener and a tailings pond are visible. There is a pile of ore nearby. This could be a uranium ore concentration plant, consistent with multiple source reports of uranium mining in this general area. The mine itself has not been found.


**Figure 2. A small ore concentration plant is visible at the location of Thabeikkyin given by the latest source.**

STW visited Thabeikkyin on two occasions, in 2006 and 2007 and reported on the following points. The first and most important is that the mission is to build a nuclear reactor and to enrich uranium for a nuclear bomb. There is considerable research work at the site devoted to this end. It is not clear that either the reactor or enrichment plant would actually be built, possibly only designed here.

He did not visit the ore plant but he did visit laboratories in small buildings with his superior, General Mg Aye. He saw two demonstrations of technology. The first was a powerful laser, reportedly a carbon-monoxide (CO) laser that was used to burn a hole in a stick. The beam was a small red spot. One of his colleagues later confided to him that CO laser beams are invisible so the spot was not from that laser, but maybe a guide or pointing laser. The audience of military offices was very impressed.

The top general in the country, Than Shwe attended a second demonstration on a subsequent visit: a "control rod drive." This consisted of a microprocessor moving a control element up and down in a laboratory. This sounds like an extremely simple task and not very impressive but again the military officers were pleased. Sai, without

prompting gave a technically credible explanation of how a control rod affects the criticality of a reactor by absorbing neutrons. Otherwise we would not be so sure that the demonstration he saw had any nuclear application.

STW told us that Dr. Ni Lar Tin was the scientist who explained to the group how a control rod works. A Dr. Daw[9] Nilar Tin is active and visible in the DAE and MOST.[10]

STW can give the names of a few researchers at Thabeikkyin. Details of the technology are in a later section of this analysis.

## *Factories 1 and 2*

The Nuclear Battalion controls two important factories. These factories are dedicated to making prototypes and special components for the missile and nuclear programs.

Number (1) Science and Technological Material Production Workshop will be abbreviated as Factory 1 in this report. It is located east of Pyin Oo Lwin (also known as Maymyo.) It was purposely built for the military research programs. Factory 1 has been more closely associated with the nuclear program than the missile program but has worked for both. It is also known by the name Naung Laing.


**Figure 3. Factory 1 is east of Pyin Oo Lwin**

[9] "Daw" is an honorific, not a name

[10] **List of Participants, RCARO/KAERI Regional Training Workshop on Research Reactor Utilization and Radiation Application Technology, Korea Atomic Energy Research Institute (KAERI), Daejeon, the Republic of Korea, 12 ~ 23 October 2009**

Factory 1 has been the subject of internet discussion in such forums as the Arms Control Wonk, where it was the subject of intense speculation as a reactor.[11] DVB has many pictures of Factory 1 under construction that can be correlated to satellite imagery, as well as the exterior of Factory 1 after completion. It is a certainty that this is a machine tool factory and not a reactor.[12]

Number (2) Science and Technological Material Production Workshop, "Factory 2," is located near Myaing in the western part of Burma. This factory is supposedly identical to Factory 1 but it is more tied to the Burmese missile program. That program is allegedly planning to make prototype parts for SCUD liquid fueled missiles. Burma has a Memorandum of Understanding (MOU) with DPRK on producing SCUDs so it is not unreasonable to consider there is a link between Factory 2 and the DPRK MOU.

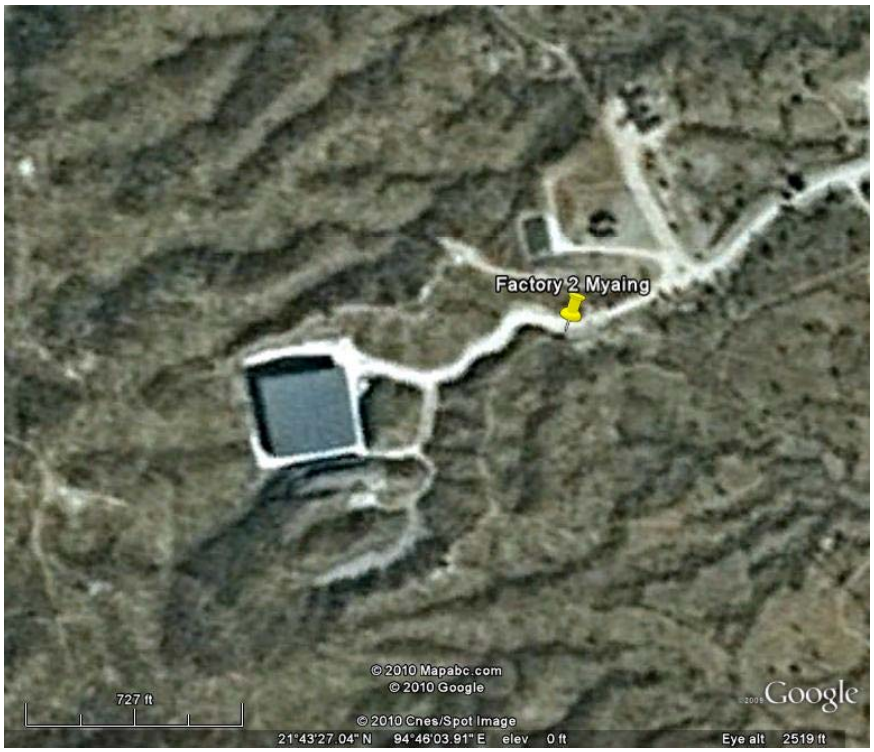



**Figure 4. Factory 2 near Myaing**

[11] For example, http://www.armscontrolwonk.com/2407/big-odd-myanmar-box, 3 August 2009
[12] http://isis-online.org/uploads/isis-reports/documents/Burma_tunnels_3August2009.pdf

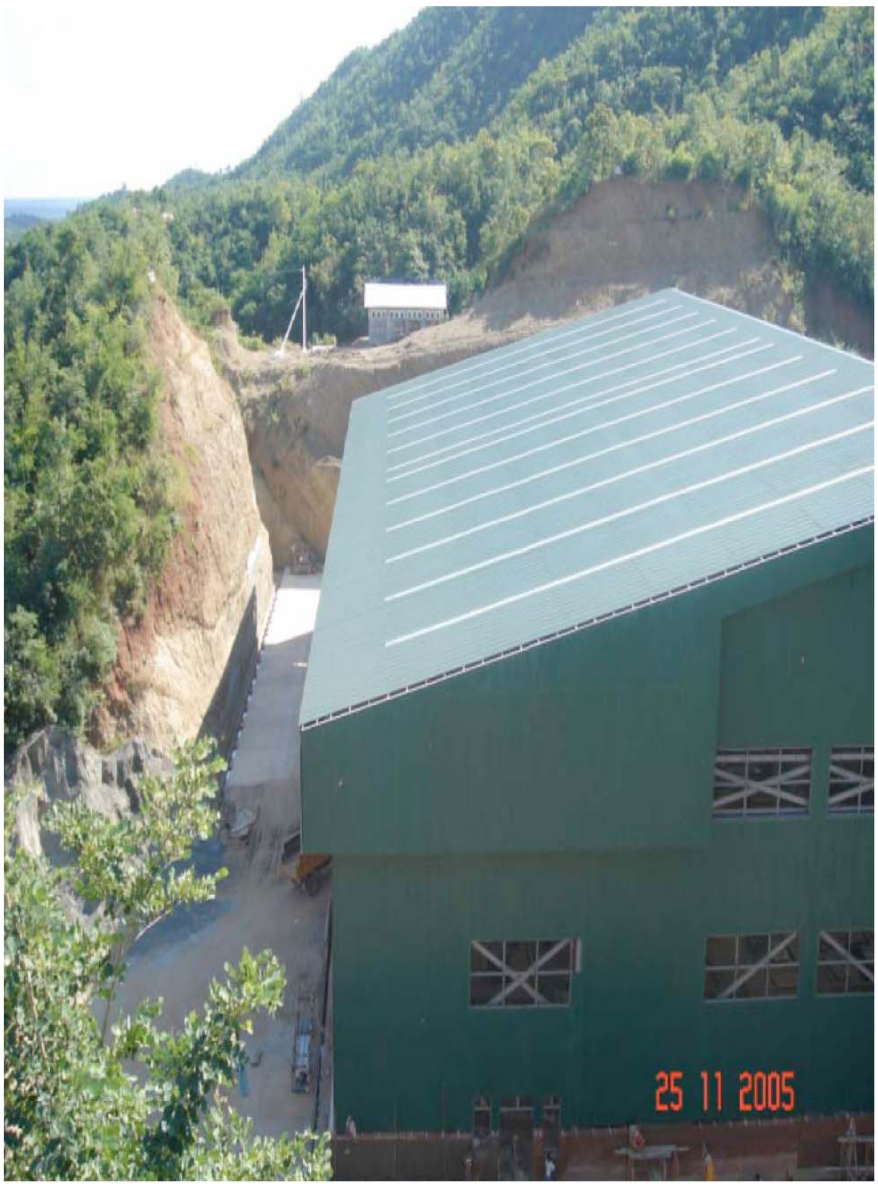



**Figure 5. Factory 2 under construction in a photo provided by STW**

The western world and DVB know a great deal about the equipment and capability inside these two buildings. A great deal of the equipment in the buildings is large scale, precision, Computer Numerically Controlled (CNC) machine tools. These tools are largely of German and Swiss origin, along with some measuring equipment from Japan.

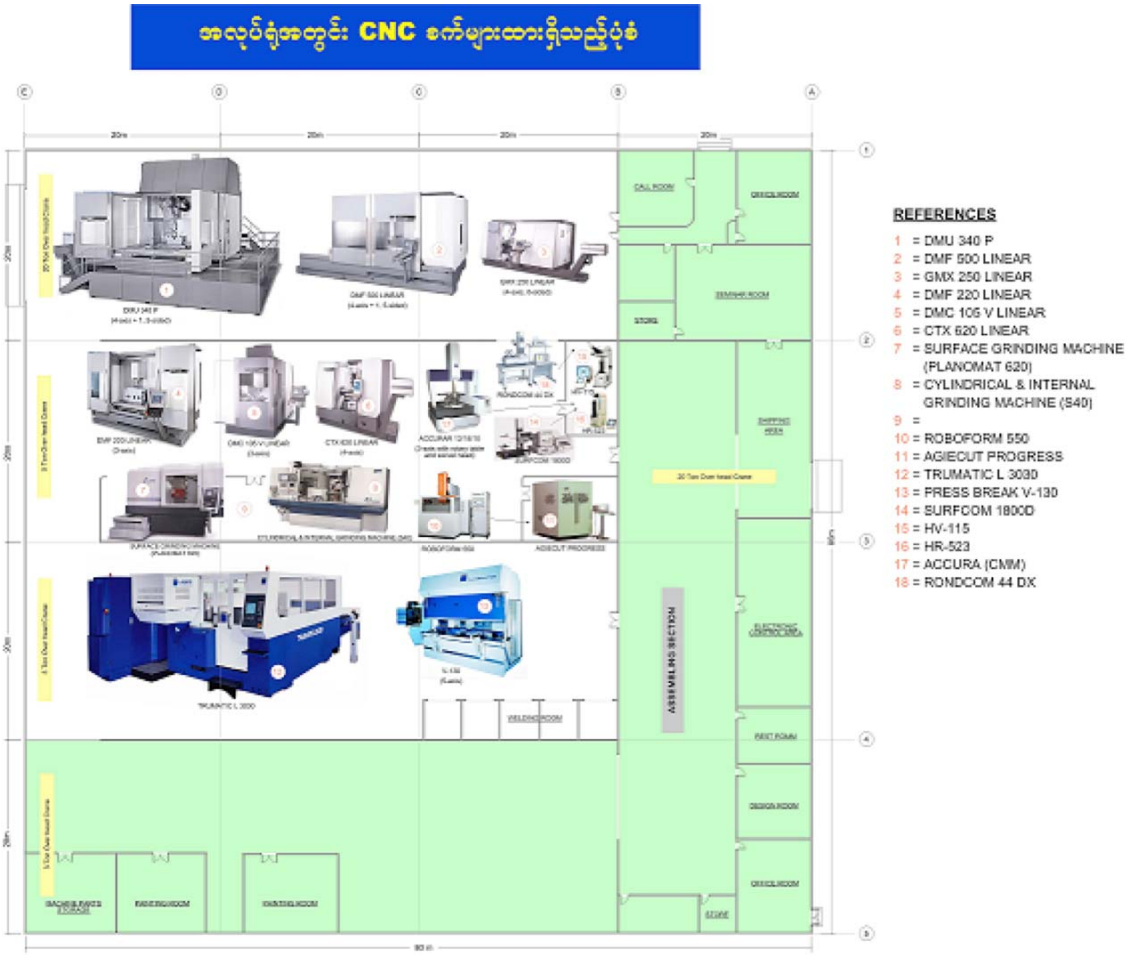



**Figure 6. Layout of Machine Tools in Factory 1 from a visitor's orientation display**

The companies which sold this equipment to Burma presumed it was being sold for educational or civilian purposes. The customer for the purchase was the DTVE. There was no derogatory information about DTVE at the time so the sale was allowed. Nevertheless, the companies did not sell the latest and best 4 and 5 axis machine tools and some of the equipment was used. Instead they removed some of these capabilities. To verify the end-use of the equipment, the German government sent an expert in machine tools along with diplomatic representatives to the factories. The expert examined the tools and made a number of observations, most of which were incompatible with the claim that the factories were just university training centers:

> The factories are far from any universities or students
> There were no females working or studying
> The equipment was extremely large for normal machinist training
> No military personnel were observed[13]

There are multiple correlations between satellite imagery, end-user verification, and photos of equipment being installed by German technicians, and even photos of the expert and the diplomat during end-user verification inspections. STW served one

[13] DVB has carefully examined photographs and noted that personnel who wore civilian clothes during the German expert visit wear military uniforms when the Europeans are not there.

and one half years as an army major and deputy director in Factory 2 and then a few months in Factory 1 in the same capacity.

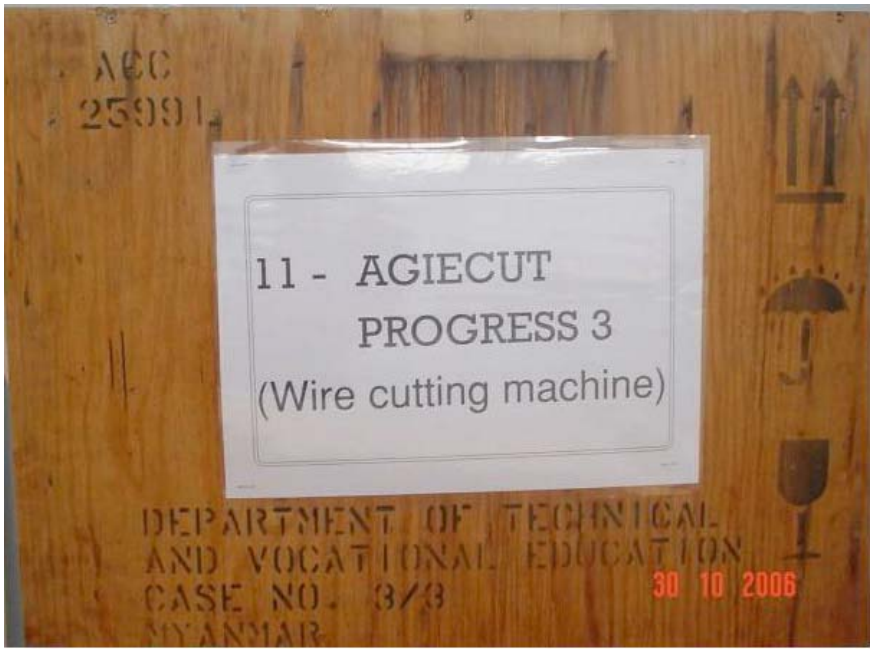



**Figure 7. Shipping crate for machine tool delivered to Factory 1 in the name of DTVE**

He indicated that many of the German tools were unusable due to damage and poor maintenance. Photos of equipment show rust, rat droppings and damaged hydraulic and electrical lines. He also indicated that failed machines are being replaced by Korean or Chinese machines.


**Figure 8. Electrical discharge machine tool display for VIP visit**

## *Training in Russia*

STW has an interesting background, according to his interviews with us and with the DVB. He received an engineering degree from the DSTA. He joined the military and later was chosen to go to Moscow for additional training in missile technology in 2001. He was in the first group of students going to Russia, a fact which has been widely reported in other sources. Sai describes how he had to appear to be a civilian for this Russian training, and so he was given a false graduation certificate from Yangon University to show to the Russians. He still has both Burmese certificates as well as a Russian certificate from the N. E. Bauman Institute, Moscow State Technical University, and (MSTU). This is a respected Russian university where he studied many aspects of missile technology. Upon return to Burma he was assigned to the Headquarters of DDSSTRC for a year. He then was assigned to Factory 2, while it was under construction and worked primarily on missiles. An example is that he programmed the CNC machines to make a prototype impeller designed at DDSSTRC; however, the impeller quality was unacceptable due to the limitations of the machine tool.


**Figure 9. The missile impeller as manufactured at Factory 2**

Sai was part of a group which received missile training. Another group, where he also had friends, was sent to Russia at the same time, circa 2001, for training in nuclear technology. Many were trained at the Moscow Engineering Physics Institute known by its Russian acronym, MIFI. This university specializes in the nuclear side of technology, such as mathematics, physics, computer codes and theory. At one time it was the primary training school for the Soviet nuclear weapons experts. Other Burmese students went to the Mendeleev Moscow Chemical Engineering Institute. This university trained the Burmese in chemical technologies related to activities such as the production of uranium compounds to be used in the nuclear fuel cycle.

After all of the students returned from Russia, STW lost direct contact with them, but he knew that the mechanical engineers with nuclear training went to Factory 1 and the ones with more specific nuclear training went to the Nuclear Battalion at Thabeikkyin. There are still Burmese military students in Russia today.

## *The Nuclear Fuel Cycle*

All of the new information brought out in photographs pertains to chemical processing. There are no pictures of nuclear bombs or reactors and only a tiny bit allegedly on Laser Isotope Separation (LIS). The information is all related to the chemical side of the nuclear fuel cycle. The technologies of interest are the following.

| Step | | Activity | |
|---|---|---|---|
| 1 | | Uranium Mining | |
| 2 | | Uranium Ore Concentration | |
| 3 | | Yellowcake Production | |
| 4 | | Uranium Oxides Production | |
| 5 | | Uranium Tetrafluoride Production ($UF_4$) | |
| 6 | | Uranium Hexafluoride ($UF_6$) | |
| 7 | | Enrichment | |
| | Gas Centrifuges | Or | Molecular Laser Isotope Separation |
| 8 | | Reduction of $UF_6$ to $UF_4$ | |
| 9 | | Bomb reduction of $UF_4$ with magnesium to uranium metal | |

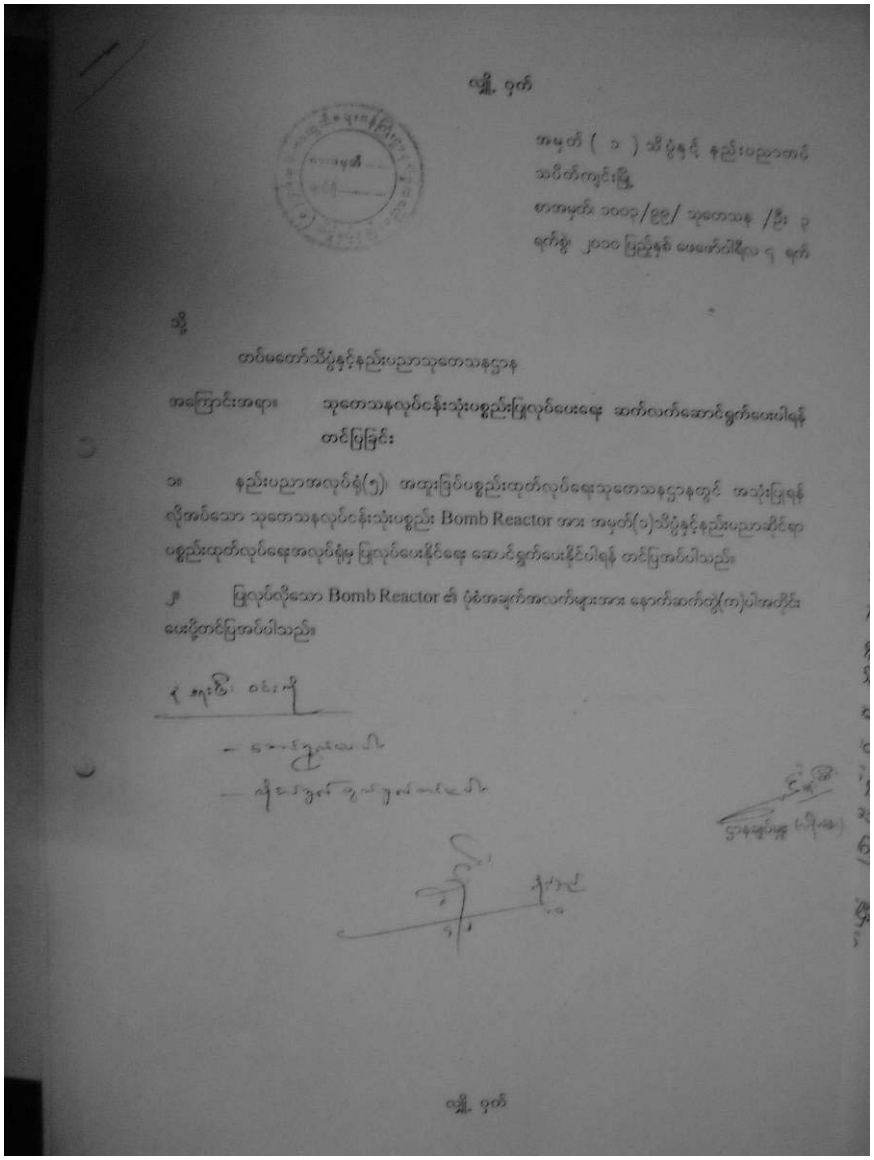
## *Equipment Built at Factory 1 for the Nuclear Battalion*

(Step numbers refer to the fuel cycle diagram above.)

### Bomb Reactor (Step 9)

The "bomb reactor" is easy to recognize from its properties and from the fact that STW supplied a letter from the Nuclear Battalion to Factory 1 requesting a "bomb reactor." The bomb reactor was to be used by the "special substance production research department." This group is located at Technological workshop (5), whose location we do not know.

"Bomb Reactor" is an unfortunate pair of words in the nuclear context. The object is not a "nuclear bomb" and it is not a "nuclear reactor." It is simply a very strong vessel to contain a violent chemical reaction. Hence it is a bomb in its strength and shape, and a reactor for containing the reaction of $UF_4$ and magnesium (or calcium) metal inside. The term bomb reactor is synonymous with "bomb reduction vessel" or even "reduction vessel." This terminology is much less emotive.



လျှို့ဝှက်

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သို့

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၁။ နည်းပညာအလုပ်ရုံ(၅)၊ အထူးခြပ်ပစ္စည်းထုတ်လုပ်ရေးသုတေသနဌာနတွင် အသုံးပြုရန် လိုအပ်သော သုတေသနလုပ်ငန်းသုံးပစ္စည်း Bomb Reactor အား အမှတ်(၁)သိပ္ပံနှင့်နည်းပညာဗဟိုဌာန ပစ္စည်းထုတ်လုပ်ရေးအလုပ်ရုံမှ မြှုပ်ပေးနိုင်ရေး ဆောင်ရွက်ပေးနိုင်ပါရန် တင်ပြအပ်ပါသည်။

၂။ မြှုပ်လိုသော Bomb Reactor ၏ ပုံစံအမျက်အလက်များအား နောက်ဆက်တွဲ(က)ပါအတိုင်း ဖေးဖို့တင်ပြအပ်ပါသည်။

လျှို့ဝှက်

**Figure 10. Original letter from the Nuclear Battalion directing Factory 1 to build a "Bomb Reactor"**

Final
25 May 2010

Secret

[Stamp of No (1) Science and Technology Regiment
Ministry of Defence]

No (1) Science and Technology Regiment
Thabeikkyin
Letter no. 1003/99/research/ Oo 3
Date, 2010 February 4

To

Army Science and Technological Research Department

Subject: Requesting the continuation of supply for materials needed for research

1. Request No (1) Science and Technological material production workshop to make Bomb Reactor needed for research material for the use of special substance production research department at technological workshop (5).
2. Send and report the formation/prototype data of Bomb Reactor needed to be made, as in Appendix (A)

Lt-Col Win Ko

- (Please) carry it out.
- Calculate necessity

(Signed)
Chief of HQs (On behalf of)

(Signature)

Secret

**Figure 11. Translation of the Letter**

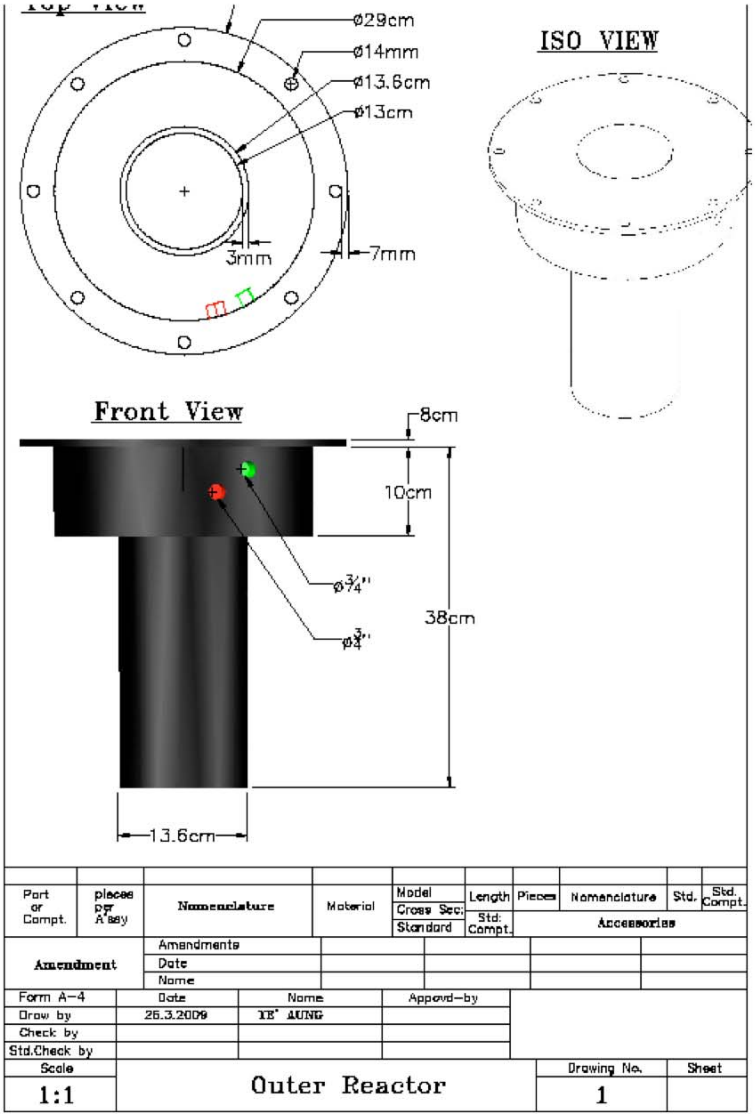


**Figure 12. Sketch for building the bomb reactor**

One thing that will jump out at the experienced reader is that there are no tolerances or materials listed on this sketch. The source himself noted that the drawings from the Nuclear Battalion were very unprofessional. This factors into our assessment that the Burmese nuclear program is quite primitive.

**Figure 13. Two bomb reactors, one used and one new**

The finished bomb reactors are pictured side by side in this image from Factory 1. One of the reactors has obviously been subjected to great heat and is discolored and paint has burned off. The other is new. There is an image of the two vessels in a packing crate being *received from* the Nuclear Battalion, so for some reason an unused vessel is being returned with an older one. STW did not see these vessels, only the photo, so he was not aware of any health and safety precautions. There are no safety precautions such as contamination control in any image of the factories that we have seen.

There is no information about ceramic crucibles, boosters, igniters or such things. The factory simply built the items and shipped them elsewhere for use. A rough estimate of the amount of metal that would be produced in this reactor is about 20 – 25 kg. That would be criticality safe and could be used for natural or enriched metal.

Bomb reduction is done in other industries besides nuclear but it is relatively rare. The technology was widely developed during the Manhattan project to make uranium metal for reactor fuel and for weapons in ton quantities. A bomb reactor built by a special factory, subordinate to the Army Nuclear Battalion is a very good indicator of a nuclear program in the context of many other things.

## Inert Atmosphere Glove Box (Step 9)

STW was proud of the construction of a simple vacuum glove box produced at Factory 1. The box was used to mix two materials together when one of them was highly susceptible to oxidation. He describes evacuating the box and backfilling it with inert argon for the mixing to take place. Our interpretation for this glove box is that it is used for mixing $UF_4$ with magnesium metal for the bomb reduction to uranium metal.

**Figure 14. Inert Atmosphere glove box. Vacuum pump is behind the man on the right.**

Vacuum glove boxes are not an everyday item in industry. This one is quite crude but STW's description of it being used to mix readily oxidizing chemicals is certainly feasible.

## Inconel Tube Fluoride Bed Reactor (Step 6)

Factory 1 put a lot of effort into building a "fluoride bed reactor". It is shown in the next figures. STW did not know the materials that were used, but the photo was found by the DVB on a CD in a file marked "Inconel."

Inconel © is a nickel based alloy used in nuclear industry applications where fluorine or hydrogen fluoride (HF) is used in the process. Fluorine is highly corrosive and destroys steels at high temperatures, such as in furnaces. Inconel is also used in a variety of other applications ranging from the natural gas industry, to turbine blades and even Formula One racing car exhausts. So the use of Inconel is not a unique signature of nuclear fuel cycle use.

The terminology used by this source, "fluoride bed reactor" does offer more clues. It would seem that fluorine is involved and fluorine is a component of the nuclear fuel cycle and a very corrosive one. $UF_6$ can be produced by placing $UF_4$ powder in a fluidized bed reactor and agitating it in a high temperature section by a stream of fluorine gas. It is likely that the assembly shown in the figure is the entire fluidized bed reactor. The can at the bottom collects solids that are not fluorinated and are not wanted in the product. The size of this reactor suggests a prototype or pilot plant size.


**Figure 15. The "fluoride bed reactor" assembly. Note the Trumabend V-130 machine on the right and the Trumatic L 3030 laser cutting machine in the background and compare to Figure 6, the shop layout of Factory 1.**

**Figure 16. Internal components of the "Fluoride Bed Reactor"**

**Figure 17. Presumed Inconel tube with the section surrounded by the furnace in the previous figures**

## Tube Furnaces (Step 5)

STW had only seen drawings of these tubes but he believed that they were for the carbon monoxide (CO) laser at Thabeikkyin. That is certainly a possibility but they appear more likely to be tube furnaces for the fluorination of solid uranium oxide powder to solid $UF_4$ powder. They are certainly tubes that have been heated and there are metal "boats" for holding powder to be reacted. Two have been subjected to heat and one appears to be new. This would be step 5 in the fuel cycle diagram above.

**Figure 18. Two used tube furnaces and one new one**

## Nitrogen Tank with steel Collectors (Step 6)

An interesting item fabricated in Factory 1 is a “Nitrogen Tank with Steel Collectors (their terminology). From its design it looks like an attempt to build a cold trap to catch $UF_6$ gas on high surface-area plates with very cold liquid nitrogen as the refrigerant.


**Figure 19. Possible cold trap assembly for collecting $UF_6$ gas**

## Other Equipment

Other items include a large mixer “Water Reduced Tank”, an “Automatic Autoclave Sterilizer”, and a “Burning Chamber”. These are not particularly unique or part of the nuclear fuel cycle. The burning chamber is shown Figure 20, only because it illustrates the crude workmanship of the items seen.

**Figure 20. This object, described only as a “burning chamber” is rather crude**

**Figure 21. "Water Reduced Tank" which appears to be a simple mixer**

## *Reports of a Nuclear Reactor*

The open source literature is filled with reports of a nuclear reactor in Burma. We are tempted to believe that this could be layman's confusion over a nuclear program in general, because uninformed sources can be very loose with terminology. One thing is clear, that many people have heard of a Russian plan to sell a reactor to Burma around 2001. It is very clear that the reactor was never sold and it seems unlikely that Russia would do so today. Russia's ROSATOM did announce intent to sell a reactor to Burma in 2007, but this deal has not been consummated owing to financial and practical legal issues.[14]

An absolute condition for Russia to sell a 10 MW research reactor would be that Burma signs the "Additional Protocol" with IAEA.[15] The Additional Protocol is a voluntary addendum to an existing safeguards agreement such as the standard INFCIRC type 153 agreement in force with Burma today. The Additional Protocol provides the IAEA with greater rights to ask for details of existing declared facilities (there are none in Burma so far) and greater rights to probe into undeclared activities of the type we are alleging. 100 countries in the world have agreed to an Additional Protocol.[16] Unfortunately, some critical ones, such as Syria, have not. With the many open source claims that Burma has a covert nuclear program, this might not be the time they would agree to sign. The Russians should not even consider selling a reactor to a state with weak and obsolete IAEA agreements.

In addition, a 10 MW nuclear reactor is a very small reactor, suited mainly for producing medical isotopes, conducting nuclear physics experiments, and training engineers and technicians in nuclear technology that could eventually be used to build a larger reactor. A 10 MW reactor is a very poor source of plutonium and is of little interest in most countries inspected by the IAEA today. It would be inspected and monitored on a routine basis and misuse would be difficult.

Therefore, reports that a reactor has been sold and that Burma is building a 10 MW reactor on its own seem far fetched and pointless.

What is of far greater concern is the possible tie to the DPRK. Some sources, albeit not well-vetted, allege that DPRK technicians are helping to build a reactor in Burma. This immediately brings to mind the 2007 bombing of a facility in Syria that allegedly was a DPRK designed plutonium production reactor. This highlights the fact that DPRK is willing to build at least one reactor outside its own territory. Thus, any rumored activity in Burma should be taken seriously. So far no sources have given adequate coordinates for a suspected nuclear reactor in Burma but this is a high priority item for more information.

[14] Russia to build Nuclear Reactor in Myanmar, New Scientist and Reuters, 15 May 2007, http://www.newscientist.com/article/dn11856-russia-to-build-nuclear-reactor-in-myanmar.html
[15] IAEA INFCIRC/540
[16] Chad became the 100th State to complete an Additional Protocol on 13 May 2010

## *Report of Laser Isotope Separation*

The DVB source provided a great deal of information on a Laser Isotope Separation (LIS) program at the Nuclear Battalion. From the outset we will readily agree with critics that a laser isotope separation program is far beyond the capabilities of Burma with its poor technical resources. Nevertheless STW has a lot of details about the program, and if Burma chooses to spend its resources in this way it is heartening to those who wish them to fail.

Laser isotope separation has been a huge research program in many countries, such as the US, UK, France, Russia, Germany, South Africa, Australia and probably others. None of these advanced industrial countries has succeeded in making significant amounts of enriched uranium at anything close to a competitive price.

There are two common approaches to Laser Isotope Separation. This is an overly detailed topic for this paper and will be summarized. STW had been clearly told that he was to make some precision nozzles for a supersonic carbon monoxide (CO) laser that would be used in the LIS process. Carbon dioxide ($CO_2$) and CO lasers are normally associated with the Molecular Laser Isotope Separation (MLIS) process. This process uses $UF_6$ as the chemical working substance, the same as centrifuge enrichment. STW was asked to machine many prototype nozzles for the lasers, in batches of ten or so. He remembers them because they were difficult to make and required electrical discharge machining, one of his special skills. A sketch of a nozzle is seen in the next figure. Note again that the sketch is not a proper engineering drawing, lacking tolerances and other information.

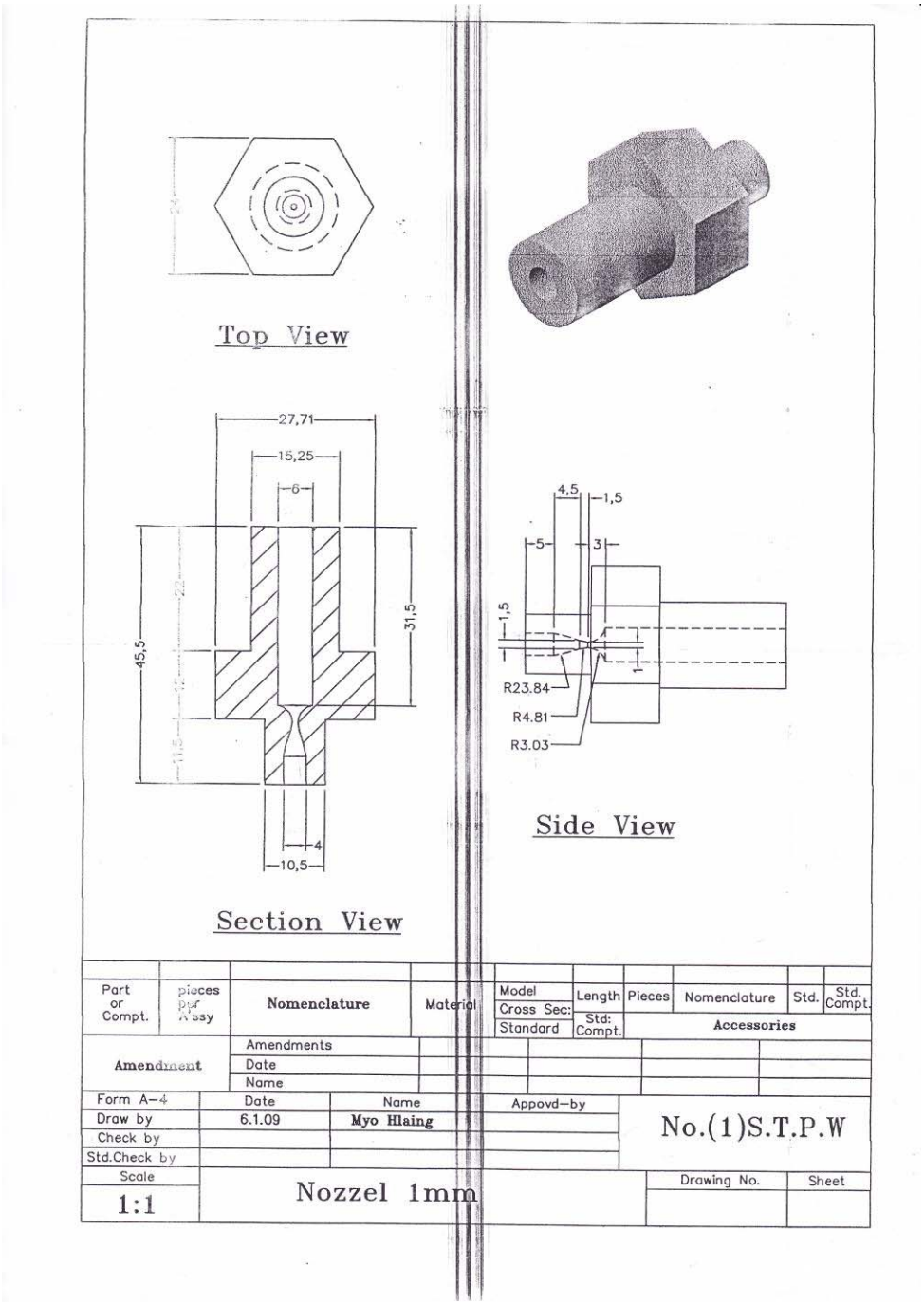


**Figure 22. Sketch of a proposed nozzle made at Factory 1 allegedly for a supersonic CO laser**

It is our view that the LIS process is far beyond the technical capabilities that we have seen elsewhere in Burma. This technology proved too complex and expensive for several industrialized states. It is common, however, in the developing world for scientists educated in universities in industrialized countries, to return home and sell high technology programs to government bureaucrats. The explanation here is probably simply that some academics have foisted this project off on the government so they can do research and publish, knowing that they will not succeed in the programmatic aim.

## *Report of a Gas Centrifuge Program*

STW heard reports of a gas centrifuge program. One of his colleagues who studied nuclear technology at MIFI in Moscow said that the Nuclear Battalion was working on centrifuges, and if a plant was built it would be near Taunggyi. The prototypes were being made of plastic as far as he knew. No further information was available on this topic.

As an aside, when STW was discussing his training in the 1990s, he mentioned fiber composites. He was aware of a military program to manufacture rocket bodies from some type of fiber. His military instructor had told the students that the process was not reliable because the tubes "vibrated too much". He had no more information on this topic and he did not tie it to enrichment himself, only as an answer to what kind of materials might be used.

## *International Agreements*

### IAEA

Burma became a State Party to the Nuclear Nonproliferation Treaty in 1992. It acquired rights and obligations under this Treaty. The agreement is known as Information Circular 477 (INFCIRC/477).[17] In particular, Burma signed a Small Quantities Protocol (SQP) with the IAEA in 1995. This stipulates that Burma has no nuclear facilities and only small quantities of nuclear materials.

Important nuclear *facilities* are defined by the IAEA as:[18]

A. Power reactors
B. Research Reactors and Critical Assemblies
C. Conversion Plants
D. Fuel Fabrication Plants
E. Reprocessing Plants
F. Enrichment (isotope separation plants)

Nuclear materials are defined essentially as plutonium and uranium, including enriched uranium, uranium-233, and uranium source materials.[19] The precise definitions are complex and are left to the interested reader.

Small quantities are defined as less than:

> (a) One kilogram in total of special fissionable material, which may consist of one of more of the following:

[17] AGREEMENT OF 20 APRIL 1995 BETWEEN THE UNION OF MYANMAR AND THE INTERNATIONAL ATOMIC ENERGY AGENCY FOR THE APPLICATION OF SAFEGUARDS IN CONNECTION WITH THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS, Information Circular 477.

[18] THE STRUCTURE AND CONTENT OF AGREEMENTS BETWEEN THE AGENCY AND STATES REQUIRED IN CONNECTION WITH THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS, INFCIRC/153 (Corrected), IAEA, June 1972

[19] "Nuclear material" means any source or any special fissionable material as defined in Article XX of the Statute. The term source material shall not be interpreted as applying to ore or ore residue.

(i) Plutonium;
(ii) Uranium with an *enrichment* of 0.2 (20%) and above, taken account of by multiplying its weight by its *enrichment;* and
(iii) Uranium with an *enrichment* below 0.2 (20%) and above that of natural uranium, taken account of by multiplying its weight by five times the square of its *enrichment;*

(b) Ten metric tons in total of natural uranium and depleted uranium with an *enrichment* above 0.005 (0.5%);
(c) Twenty metric tons of depleted uranium with an *enrichment* of 0.005 (0.5%) or below; and
(d) Twenty metric tons of thorium.

These limits appear complex, but the one of main interest is (b), ten metric tons of natural uranium. If Burma is operating an ore concentration plant and producing yellowcake it will have to consider this limit.

Burma is bound to report the import or export of nuclear materials even in small quantities, or if it acquires materials in excess of the limit. If it constructs a nuclear facility it must notify IAEA six months before receiving nuclear material for it. An R&D facility operating a single centrifuge on $UF_6$ gas would have to be reported to the IAEA as an enrichment plant, as would plants for testing uranium conversion.

In addition, "in its efforts to promote wider adherence to the IAEA's strengthened safeguards system, the IAEA has invited Myanmar [sic] to conclude an additional protocol (AP) to its safeguards agreement and to amend its small quantities protocol in line with the revised text approved by the IAEA Board of Governors in September 2005. Concluding an additional protocol would grant the IAEA expanded rights of access to information and sites."[20]

In other words, the IAEA conducts no safeguards inspections in Burma at the present time and would have no right or obligation to do so unless Burma notifies the IAEA of a change in status. Clearly Burma has not done that up to this time. Note that other elements of the IAEA do interact with Burma and carry out visits.

These have to do with IAEA Department of Technical Cooperation grant programs in medicine and other civilian nuclear technologies[21] and a program to establish a nuclear science and technical training center for scientists, engineers, technicians and graduate students.[22] IAEA's Department of Nuclear Energy also reportedly visited to give advice on whether Burma had sufficient technical ability to run the nuclear reactor that Russia planned to sell. They reportedly advised that Burma was not ready for this technical challenge. It is also notable that not all training is in the civilian area. Two Myanmar researchers in 2003 and 2005, respectively, participated in six-month programs at the Korea Atomic Energy Research Institute in the fields of

[20] IAEA public information spokesman, 18 September 2009

[21] Such as: Ministry of Science and Technology, MOST, Government of Burma, IAEA Technical Cooperation Expert Mission to Dept. of Biotechnology, Yangon (IAEA project and task MYA/0/007-12) on Transfer of Molecular Market Technologies.
http://www.most.gov.mm/techuni/index.php?option=com_content&task=view&id=42

[22] TC Project MYA/0/007, Nuclear Science and Technology Training Centre, http://www-tc.iaea.org/tcweb/projectinfo/projectinfo_body.asp

research reactor technology and advanced spent fuel management, which is inconsistent with their lack of declared nuclear fuel cycle programs. [23]

### End User Certification

The DTVE purchased equipment for two factories and claimed to the vendors that it was for educational, non-military use. Based upon STW's evidence, military personnel work in the facilities making prototype parts for weapons of mass destruction and delivery systems. It would therefore seem appropriate to sanction the DVTE and entities associated with it such as DAE and MOST from any further purchases of manufacturing, machining and inspection equipment on the basis of a false end-user certification. This would include spare parts and assistance for the machines already acquired. States participating in, for example, the Nuclear Suppliers Group (NSG) and the Missile Technology Control Regime (MTCR) should be advised of these findings.

## Conclusions

A single source, a former major in the Burmese Army, has come to the Democratic Voice of Burma with a large volume of information purporting to show missile and nuclear activities in Burma up until the present. The first question that interested observers will ask is about the credibility of the information. The source and DVB have strong feelings about the regime. Their objectivity can be called into question and so they have asked us to do this independent assessment of the information.

The following points show the overall consistency of the information. But each reader will have to make up his or her own mind.

> Sai was well-positioned to acquire information. He was an army major, trained in military science with further training in Russia. He reports credibly about his education at the Bauman Institute in Moscow and on colleagues who studied at MIFI and Mendeleev Institute.
> *Many source reports describe the additional training of young military officers in elite Russian universities. This is more quantitative and first-hand than many other open source statements.*
>
> The source was a deputy manager in two factories producing parts for missiles and nuclear programs.
> *These factories are well-known. There have been end-user certification visits to both and the details of machine tools dates and customers match. There are photographs of tools and the European installers and inspectors. The German end- user expert did not see military personnel but noted discrepancies in the Burmese story that DTVE operated the factories for student training.*
>
> The source visited Thabeikkyin with two General Officers and saw crude demonstrations of alleged nuclear technology.

[23] IAEA probes Myanmar data, discourages new research reactors, Mark Hibbs, Nuclear Fuel, August 10, 2009.

*A "Nuclear Battalion" at Thabeikkyin has been reported by other sources in sketchy detail. This new information allows more investigation especially using satellite imagery.*

The source reported that uranium ore was being processed at Thabeikkyin and that it was hazardous to health.
*Other sources mention Thabeikkyin in very general terms and also claim that the reactor might be built there. One satellite image shows a small ore concentration plant on a pond and piles of earthen materials nearby. This is not proof of a uranium plant, but consistent.*

The source provided a document about a "bomb reactor" being built for the Nuclear Battalion at Thabeikkyin along with several photos.
*The object certainly looks like a bomb reduction vessel and one of the two seen has been subjected to high temperatures.*

Other equipment, notably an inert atmosphere glove box for mixing reactive chemicals, a "fluoride bed reactor," $UF_6$ cold trap and tube furnaces are all components of a possible program to make uranium compounds for a weapons development effort.
*This is consistent with a program to make $UF_6$ for enrichment by MLIS or centrifuge and uranium metal for a possible bomb core.*

From all of the above we conclude that it is likely that Burma is trying to attempt many of the nuclear program steps reported by previous sources. Unrealistic attempts, such as the Molecular Laser Isotope Separation project, unprofessional engineering drawings and the crude appearance of items in photos, suggest that success may be beyond Burma's reach.

Nevertheless, the intent is clear and that is a very disturbing matter for international agreements. If experiments with uranium are taking place, or significant quantities of uranium compounds are being produced, then Burma needs to be reporting to the International Atomic Energy Agency, which clearly it is unlikely to do if it is planning a covert nuclear reactor, an enrichment program and a weapon.

The authenticity of the photographs and reports will no doubt be questioned. That is fair and professional. The purpose of this report is to inform and generate thoughtful analysis. The source and chain of custody of this information is clearer than the recent "laptop documents" about Iran's alleged nuclear weapon program, for example, and that has generated considerable analysis and speculation. Undated and unsourced photos of a reactor under construction in Syria are largely unchallenged. It would seem reasonable to question the authorities in Burma and to hear their explanations.

If, Burma denies the authenticity of this information, then time will be the judge. If the authorities deny the information and then are found to have not told the truth, the international reaction should be swift and severe so that Burma does not reach the immunity that DPRK has acquired with its nuclear weapons program.